

TRANSILLUMINATION OF THE BREAST

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TRANSILLUMINATION as a diagnostic aid in medicine has been largely confined to a very limited group of pathological conditions. Although this method has been employed for many years in the diagnosis of inflammatory conditions of the sinuses and in the differential diagnosis between cystic and solid tumors of the testis, its use in the breast before 1929 had been totally neglected. A careful review of the literature at that time failed to reveal any reports dealing directly with the use of transillumination in the differential diagnosis of breast tumors.

In June, 1929, the writer¹ reported the results of transillumination in a series of 176 breast lesions examined in the Memorial Hospital. Following this initial report the method was adopted in various American and European clinics. Since the writer's original communication, further observations have revealed some points of interest and practical importance in the use of this method. It is the purpose of this communication to relate briefly these newer observations, to state the conditions under which transillumination is an aid in the differential diagnosis of lesions in the breast and particularly to reemphasize some of the necessary precautions in the technic of examination and the interpretation of the findings.

When it is considered that a hydrocele transmits light readily and thus establishes the presence of clear fluid, it is at once obvious that a cyst of the breast containing clear fluid would transilluminate with equal facility. The importance of establishing the exact physical nature of a breast tumor is self-evident. For example, Bloodgood has demonstrated that a palpable cyst containing clear fluid is usually a benign lesion, whereas a cyst containing bloody fluid is, in the majority of instances, malignant. Sir Lenthal Cheate² and Bloodgood agree that once a cyst becomes clinically palpable it may be regarded, with rare exceptions, as benign whereas the dangerous cysts are those of microscopic dimensions.

When a tense cyst is situated deep in the breast, it may be extremely difficult to detect its cystic character. Under these circumstances a deeply situated, benign cyst is usually regarded as a solid tumor and the radical operation is performed when only a local excision is necessary. This error is especially likely to occur when a superimposed inflammation gives rise to slight adherence of the overlying skin. The clinical picture of a firm tumor associated with skin adherence often leads to a diagnosis of carcinoma and the radical operation.

The conception that the transmission of light through tissue might yield information of practical value in diagnosis was first developed among the

members of the laboratory staff of the Memorial Hospital (New York) during the routine examination of breast specimens. The marked variations in the degree of translucence in different portions of normal and pathological tissues was especially impressive. These observations suggested the possibility of establishing some points of difference between tumors of different density. The problem of testing the translucence of various breast tumors instituted at the suggestion of Ewing was pursued by Adair,³ who encountered difficulties because of the excessive heat developed by the transilluminating lamp.

It is important to appreciate that in common with other diagnostic methods, transillumination is an aid and not an absolute means of diagnosis. The method is based upon the varying translucence and opacity of different tissues. In the interpretation of the transillumination findings a knowledge of the underlying pathology of breast lesions is essential. Thorough familiarity with the gross anatomical and microscopical structure of lesions in the breast renders an interpretation of the transillumination findings more simple and leads to a more accurate judgment of the physical nature of the tumor. This information taken in conjunction with the clinical history and clinical findings enable differential diagnosis to be made with a greater degree of accuracy. With certain exceptions, transillumination alone has not enabled a differentiation between benign and malignant solid tumors nor can this accomplishment be expected. If the solid tumor is a hæmatoma this distinction is made without difficulty and the method constitutes the only non-operative means of establishing the diagnosis.

Technic.—Unless transillumination is performed in a totally dark room the result of the examination is not satisfactory. The transilluminating lamp must be a cold lamp of sufficient intensity to penetrate the tissues of the breast. It must be attached to a rheostat so that the intensity of the light can be varied conveniently by the examiner. The lamp must be so constructed as to permit the light to emanate from one point only in order that the light from this single source can be directed to the particular portion of the breast under consideration. The patient is placed in a sitting position and both breasts are examined routinely. The general scheme is to place the light directly beneath the lesion in question so that the part of the breast under consideration lies between the light and the examiner's eye. It is obvious that tumors that are attached to the chest wall are not amenable to transillumination. Under these circumstances the diagnosis is usually clear without the aid of this method. In tumors situated deeply in a thin, flat breast it may be more convenient to transilluminate from side to side.

It is necessary to emphasize that careful attention to the intensity of the light is a most important detail in the technic. The most formidable source of error is the over-illumination of small solid tumors thus establishing a false translucence. This error usually occurs when the tumor is small and especially when because of its superficial situation in a thin, flat breast the strong

light is placed in close proximity to a small mass. Under these circumstances the light diffuses around the tumor and a shadow cannot be detected. If the lamp is held in place and the intensity of the light reduced by means of the rheostat, a shadow will be noted which is faint at first but increases as the intensity of the light is diminished. It is highly important, therefore, when examining small lesions to reduce the intensity of the light to a minimum and to interpret the faintest shadow as positive. This important detail was pointed out in the original description of the method and was subsequently reemphasized when it was learned that this source of fallacy had not been sufficiently stressed.⁴

Fat is highly translucent, consequently the large fat breasts transilluminate very satisfactorily. Dilated ducts and acini filled with epithelial debris and stagnant secretions are opaque to transillumination. Breasts in which this process is pronounced fail to transmit light readily. Breasts which are the seat of Schimmelbusch disease may fail to transmit light of the intensity usually employed.* The satisfactory transillumination of these breasts requires a light of greater intensity.

The technic of transillumination of the breast is relatively simple. The patient is examined while sitting on a revolving chair. The lamp is held against the under surface of the breast and gradually moved as different areas in the breast are inspected successively; the object being to place the particular site in question directly between the light and the examiner's eye. By means of gentle pressure on the upper surface, thus compressing the organ between the hand above and the light beneath, the degree of translucence may be increased. The tail of the breast is best transilluminated by placing the small curved lamp underneath the axillary fold, and directing the light anteriorly.

The Normal Breast.—Marked anatomical and physiological variations in normal breasts are well recognized. The appearance of the normal transilluminated breast depends upon its anatomical structure which in turn depends, to some extent, upon its physiological state.

The wide variation in the anatomical constituents of the normal breast is paralleled by corresponding differences in the degree of translucence. Fat is highly translucent; fibrous tissue is less translucent. Solid epithelial masses, fibro-epithelial masses, and epithelial debris are moderately opaque and blood is intensely opaque. Fat breasts transilluminate well regardless of their size. As the fibrous and epithelial contents of the breast increase, the degree of translucence diminishes.

A breast which is the seat of mazoplasia (chronic mastitis) is less translucent than a perfectly normal breast. The diffuse opacity is more marked before and during the menstrual periods when the hyperplasia of the duct

* The author is grateful to the General Electric Company for its aid and coöperation in developing a more intense light, and to Doctor Failla for his help in constructing a special lamp suitable for transillumination in these cases.

and acinous epithelium is most pronounced. Dilated ducts and acini filled with desquamated epithelial débris are barriers to the passage of light; consequently parts of the breast in which the hyperplastic process is most marked show corresponding relative opacities.

It is important to point out that small, flat, non-pendulous breasts closely applied against the chest wall are unsuitable for transillumination. Lesions situated in the depth of this type of breast cannot be transilluminated satis-



FIG. 1.—Appearance of the normal breast on transillumination.

factorily as it is practically impossible to place the lesion between the lamp and the examiner's eye. Superficial lesions, however, can be examined quite satisfactorily by transilluminating with a small lamp from side to side.

Cystic Tumors.—Cysts containing clear fluid are translucent. This finding renders transillumination a valuable aid in the interpretation of the physical nature of tumors in the breast in which clinical examination leaves a doubt as to the solid or cystic nature of a mass.

The absolute knowledge of the precise physical nature of a breast tumor is usually of considerable prognostic diagnostic and therapeutic importance. In many instances, clinical examination alone yields sufficient information to establish the diagnosis. That errors in differential diagnosis in this field occur with marked frequency is well known to all who have examined a considerable number of breast tumors and followed them to operation. An

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early and very cellular carcinoma may present a circumscribed elastic tumor that gives many of the physical signs of a benign cyst. The true nature of the lesion is discovered only after local excision and section of the tumor. Deep-seated cysts distended with fluid fail to give fluctuation on palpation and present many of the clinical signs of carcinoma. This error is most likely to occur when the superimposition of an inflammatory process causes slight adherence of the mass to the overlying skin. Under these circumstances a simple benign cyst gives the impression of a firm solid tumor and in the presence of skin adherence, the logical diagnosis of carcinoma is made.

A knowledge of the nature of the cyst contents may be of considerable help. A clinically palpable cyst filled with clear fluid usually signifies a benign lesion. If the cyst contains blood there is strong evidence of intracystic papilloma or duct carcinoma. The opacity of blood is intense and transillumination enables a differential diagnosis between a cyst containing clear fluid and one containing blood.

Solid tumors are opaque to transillumination. The opacity



FIG. 2.—Opacity on transillumination of a solid tumor in the breast.

corresponds to the extent of the mass. The character of the opacity differs from that caused by the presence of blood in being much less intense. Thus transillumination enables a differential diagnosis between cysts filled with blood and solid tumors (carcinoma or fibro-adenoma).

Lactation—Galactoceles.—The lactating breast is totally opaque to transillumination. The opacity of milk is also demonstrated by the appearance of a galactocoele on transillumination. The tumor presents a sharply circumscribed and opaque shadow. Since the differential diagnosis of galactocoele

from other lesions in the breast is usually not difficult clinically, the practical application of this finding is of limited value. In certain cases, however, in which the clinical diagnosis is otherwise in doubt, transillumination may prove to be of considerable help in interpreting the precise nature of the lesion.

Hæmatoma.—The intense opacity of blood to transillumination has been pointed out. In view of this observation it was expected that hæmatoma of the breast following injury might present a special appearance on transillumination. The frequency with which a history of trauma is volunteered by the patient as a cause of lumps in the breast is well known. Since the breast is an organ subject to frequent and repeated trauma, the correct evaluation of such information is exceedingly difficult. The peculiar tendency of the

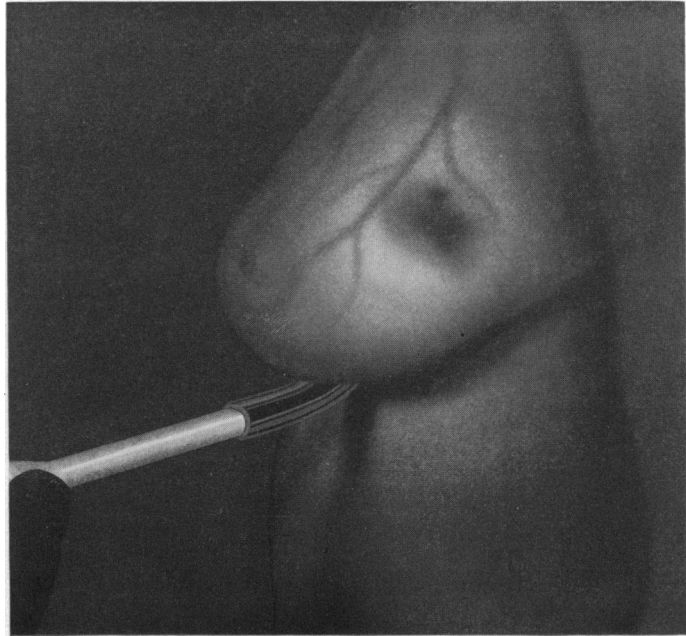


FIG. 3.—The appearance of a hæmatoma on transillumination. The opacity is intense, uneven and irregular in outline.

patient to attribute a lump to a specific cause, and more particularly to trauma, is well known and upon careful questioning the fact is often elicited that no relationship exists between the trauma and the tumor. On the other hand, a direct and inseparable causative relationship between trauma and tumor formation cannot be escaped in certain cases even on the closest critical analysis.

In some cases a definite trauma to the breast is soon followed by the appearance of a discrete tumor. Discoloration of the skin may or may not have been noticed by the patient. In these cases a differential diagnosis between hæmatoma and beginning carcinoma is exceedingly difficult, yet most important from a therapeutic standpoint. Frequently, slight skin adherence complicates the clinical picture and renders a diagnosis still more difficult.

Transillumination has been found to be of considerable aid in the differential diagnosis under these conditions. The opacity of a hæmatoma, being due to unabsorbed blood, is intense. The opacity varies in degree according to differences in the amount of unabsorbed blood pigments in various portions of the lesion. The edges are irregular in outline and extend into the surrounding breast tissue beyond the palpable edge of the tumor. This irregular edge is due to the extravasation of blood into the surrounding tissues.

When the lesion is examined at repeated and frequent intervals after the injury it is noted that the opacity slowly diminishes in extent and intensity and finally completely disappears. In several cases three months elapsed before the final and total disappearance of the opacity. The diminution in the extent and intensity of the opacity is accompanied by a corresponding decrease in size of the tumor.

These transillumination findings may be readily correlated with the changes known to occur in the various stages of hæmatoma formation and absorption, remembering that the opacity is due to the unabsorbed blood pigments. The opacity found in this state is unlike that seen in any other condition. It differs from that caused by an intracystic papilloma in that the latter produces a circumscribed uniform shadow with sharply defined edges. It differs from the opacity of a solid tumor such as carcinoma, in its intensity, which is never equalled by any lesion in which blood pigments do not participate.

In cases of this type, in which a differential diagnosis between hæmatoma and beginning carcinoma must be made at once, transillumination may be the means of preventing an unnecessary mastectomy. In several cases the breast was saved because of these findings. If the characteristic shadow of hæmatoma is discovered by transillumination, it is safe to withhold operation and examine the breast at frequent intervals. The slightest diminution in size of the mass accompanied by a decrease in the extent and intensity of the opacity is an indication that a hæmatoma exists and is undergoing absorption. Under observation the entire mass may disappear and an unnecessary operation is thereby avoided.

Transillumination of the Breast in the Presence of a Hæmorrhagic Discharge from the Nipple.—In order to interpret correctly the transillumination findings in this group of cases it is important to refer briefly to the pathological anatomy underlying this syndrome. Although numerous important researches have been conducted in this field it is a remarkable fact that the significance of a hæmorrhagic discharge from the nipple still remains a matter of dispute among clinicians and pathologists. Some investigators hold that a hæmorrhagic discharge from the nipple of a non-lactating breast is evidence of a benign rather than a malignant lesion and is an almost positive sign of intracanalicular papilloma. (Bloodgood,⁵ Greenough and Simmons,⁶ Deaver and McFarland,⁷ Sistrunk⁸) Miller and Lewis,⁹ on the other hand, found the same proportion of benign and malignant tumors associated with

this sign and Judd,¹⁰ in a review of one hundred cases, reached a similar conclusion.

Studies of whole sections of the mammary gland in cases of bleeding nipple have yielded important information concerning the underlying pathological process. By this method Sir Lenthal Cheate¹¹ has demonstrated that papillomata are more often multiple than is generally supposed. The uniradicular type of papilloma, usually multiple, occurs in the deeper portions of the breast and is rarely malignant. The multi-radicular type, usually occurring singly, and situated near the ampulla of the ducts, is more likely to undergo malignant changes. In a study of a large series of breasts associated with bleeding from the nipple, Knoflach and Urban¹² found that the common lesion is a circumscribed, mostly single, occasionally multiple, papillary growth in ducts or acini, showing the histological features of a benign process. Adair,³ on the other hand, in a recent and very comprehensive study of an extensive series of cases of bleeding nipple, found that 50 per cent. of the lesions were malignant.

Careful palpation of a breast which is the seat of bleeding from the nipple sometimes reveals a tumor or a localized nodularity. In most cases, however, palpation of the breast fails to show a localized tumor and if an indefinite tumor or nodularity is discovered it may not constitute the lesion which causes the bleeding. In the absence of a localized tumor, point pressure in the region of the areola may help in localizing the lesion but this test often fails.

Owing to educational propaganda within the last few years, women now come for examination soon after a hæmorrhagic discharge from the nipple is detected. Consequently the proportion of cases in which a hæmorrhagic discharge from the nipple is unaccompanied by the presence of a palpable tumor, is constantly on the increase. Within the last few years the majority of such cases have applied for treatment so soon after observing this sign that no palpable evidence of the disease existed when the breast was first examined.

The inability to localize the lesion in cases of bleeding from the nipple is extremely embarrassing, from a therapeutic standpoint. Those who look upon this sign as of serious import, practice the removal of the entire breast. This is certainly the safest procedure but in view of the fact that the underlying lesion is often a simple benign papilloma, a removal of the entire breast may be unnecessary in many cases. Bloodgood reports two cases in which the breast was removed and small benign papillomatous cysts containing blood were found when the breasts were sectioned. Miller and Lewis⁹ state that when a serohæmorrhagic discharge occurs and no tumor is palpable, the lesion is, in all probability, a small benign intracanalicular papilloma situated deep in the substance of the breast and should be removed locally. Knoflach and Urban¹² comment on this group of cases and point out the difficulties in localizing the lesion. They state that in many cases it is not possible to locate a point at which pressure causes bleeding from the nipple even after repeated

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examinations. Thus it is obvious that any procedure which enables an accurate localization of the lesion and a better conception of the distribution of the disease throughout the breast would be of considerable help in the treatment of these cases.

The intense opacity of blood has been pointed out. The most striking feature of the transillumination of the normal breast is the prominence of the blood vessels. In view of these findings it was logical to expect that an intracystic papilloma associated with bleeding would yield an opaque shadow on transillumination. This suspicion was readily confirmed when the first breast was examined by this method. It soon became evident that this simple procedure constituted an invaluable aid in the localization of the small intracystic papillomata associated with bleeding from the nipple.

An intracystic papilloma which is accompanied by a hæmorrhagic discharge from the nipple presents a discrete and well circumscribed opacity that is characterized by two features: (1) its intensity; and (2) its sharply outlined periphery. In some examples, not only has the papilloma itself been localized, but the duct filled with blood leading to the surface of the nipple, could be readily followed throughout its course.

It is important to emphasize in this connection that minute papillomata may fail to cast a shadow. It is very important, when attempting to localize these small lesions, to reduce the intensity of the light to a minimum. The most common error that is made and one that leads to a failure to localize the small lesions is over-illumination. This error is especially likely to occur when the small lesion is situated close to the surface of the breast.

If a local excision is to be performed, it is important to mark the skin directly overlying the opacity with indelible ink or with silver nitrate. This procedure must be carried out while the patient is lying in the same position in which she is to lie when the tumor is to be excised. These precautions greatly facilitate the surgical procedure. In rare cases, neither palpation nor transillumination reveals the site of the lesion. In two such examples the lesion proved to be very early duct carcinomata. No tumor could be felt on palpation and the transillumination findings were negative. Both lesions were of microscopical dimensions.

Multiple Papillomata.—Whereas in most cases a hæmorrhagic discharge from the nipple is caused by a single localized and circumscribed lesion, the underlying cause in some cases consists of a diffuse pathological process with numerous minute papillomata in dilated ducts. Although the association of multiple papillomata with a hæmorrhagic discharge from the nipple has been previously recognized, a clinical differentiation of these cases from those in which a single lesion is the causative factor has not heretofore been possible. This group of cases presents an important therapeutic problem. Knoflach and Urban¹² advise a complete mastectomy in this group as against a local excision in the other group. Their procedure consists in local excision of the suspected area, and, if the microscopic examination of the excised specimen indicates a diffuse process, a second operation is performed and the

entire breast is removed. This double procedure is necessitated by the inability to differentiate clinically between cases of single and multiple lesions. These authors report three cases in which local excision alone failed to stop the bleeding from the nipple, one case requiring a second operation. They warn against a too narrow excision because of the danger of leaving pathological tissue in the breast. Transillumination of the breast in these cases presents a striking picture consisting of multiple small opacities throughout the affected breast and sometimes also in the opposite breast. The opacities are intense, discrete, and localized. Adair³ has found transillumination a valuable aid in the diagnosis and treatment of this group of cases.

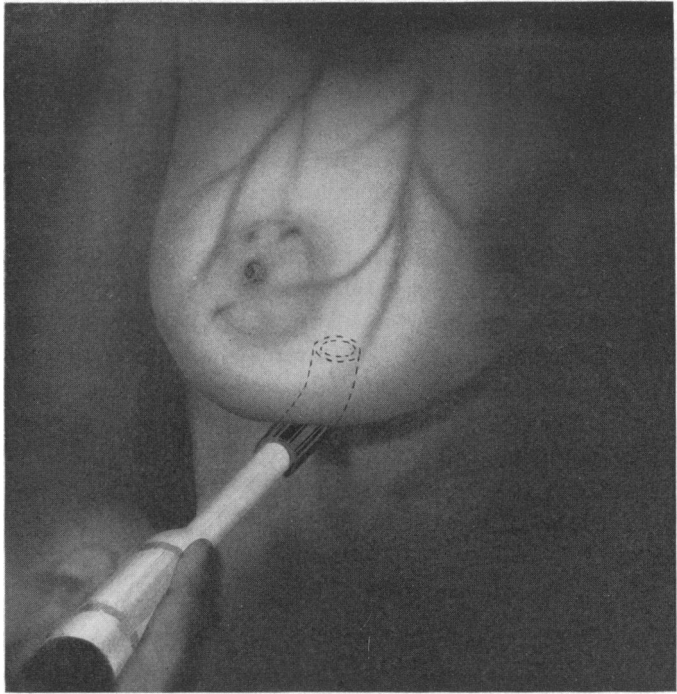


FIG. 4.—Multiple opacities seen on transillumination of a breast containing several papillomata.

It is important to emphasize that when the discharge from the nipple is not distinctly hæmorrhagic, localization by transillumination is often impossible.

SUMMARY AND CONCLUSIONS

1. Transillumination is a practical aid in the differential diagnosis of pathological conditions in the breast.
2. Different tissues display varying degrees of translucence. Fat is highly translucent. Fibrous tissue is less so. Epithelial and fibro-epithelial masses are opaque and blood is intensely opaque.
3. Transillumination enables a more accurate estimate of the physical nature of a tumor than can be gained by inspection and palpation alone. This

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information, correlated with a careful history and with the physical findings enable a more accurate judgment of the underlying pathological process than can be gained without the use of this method.

4. The normal breast presents marked variations on transillumination depending upon the relative content of fat, fibrous tissue and epithelial elements.

5. Three important technical details, to a large extent, determine the success or failure of this method. (1) The room in which the examination is performed must be totally dark. (2) When examining small lesions the intensity of the light must be reduced and the faintest shadow must be interpreted as positive. (3) In examining certain breast lesions (Schimmelbush disease) the intensity of the light must be markedly increased.

6. Solid tumors are opaque to transillumination. The opacity lacks the intensity of the shadow cast by blood. The character of the opacity in itself does not permit of a differentiation between benign and malignant tumors.

7. Cysts containing clear fluid are translucent. This finding may be of considerable aid in differentiating between carcinoma and tense, deeply seated cysts which present the clinical features of solid masses.

8. The intense opacity of blood is one of the most characteristic and important findings in the transillumination of different tissues.

9. Traumatic hæmatoma presents a specific and characteristic appearance on transillumination. The opacity is intense, uneven and irregular in outline. When the lesion is examined at repeated intervals the opacity diminishes in its extent and intensity and finally disappears as the blood pigments are absorbed. This finding may be of considerable importance in differentiating this lesion from carcinoma especially when traumatic hæmatoma is accompanied by skin adherence.

10. Intracystic and duct papilloma associated with a hæmorrhagic discharge from the nipple, present a characteristic appearance on transillumination. The opacity is intense, uniform and sharply circumscribed.

11. Transillumination is especially helpful in cases presenting a hæmorrhagic discharge from the nipple in which no tumor can be palpated in the underlying breast. In this group of cases transillumination may constitute the only available method of localizing the lesion and indicating the site for surgical removal.

12. A hæmorrhagic discharge from the nipple may be associated with a single papilloma or with multiple papillomata. Multiple papillomata (with the exception of microscopical lesions) present multiple opacities. Transillumination is therefore of considerable aid in determining the extent of the disease in the underlying breast and constitutes the only non-operative means of differentiating between single or multiple lesions. This determination is of special importance from a therapeutic standpoint in indicating the extent of the surgical procedure.

13. The practical importance of differentiating between single and multiple papillomata is emphasized by those examples in which the local removal

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of a duct papilloma has been followed by further bleeding from the nipple. Subsequent transillumination in these cases has revealed the fact that only one of numerous papillomata had been removed.

14. Transillumination is a simple procedure and a valuable aid in the interpretation of pathological conditions in the mammary gland. Its use is recommended in the routine examination of the breast.

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